

stable platform for the track would be compacted to meet design requirements. Water could be shipped from other locations or obtained from wells drilled along the route.

Railroad track construction would consist of the placement of railbed material, ties, rail, and ballast (support and stabilizing materials for the rail ties) over the completed railbed platform. Other activities would include the following:

- Installation of at-grade crossings (which would require rerouting existing utility lines in some areas)
- Installation of fences along the rail line, if requested by other agencies (for example, the Bureau of Land Management or the Fish and Wildlife Service)
- Installation of the train control system (monitoring equipment, signals, communications equipment)
- Final grading of slopes, installation of rock-fall protection devices, replacement of topsoil, revegetation and installation of other permanent erosion control systems, and completion of the adjacent maintenance road

2.1.3.3.2 Rail Line Operations. Branch rail line operations from the junction with the main line to the proposed repository at Yucca Mountain would meet Federal Railroad Administration standards for maintenance, operations, and safety. Current plans for the branch rail line anticipate a train with two 3,000-horsepower, diesel-electric locomotives; from one to five railcars containing spent nuclear fuel and high-level radioactive waste; *buffer cars*; and escort cars. Trains could also haul other freight to and from the repository site, thereby decreasing the truck traffic on local roads. The EIS analyses assumed that all repository construction materials and equipment would be transported to the Yucca Mountain site by truck.

The operational interface between the Union Pacific and the branch rail line would be determined by whether the waste was shipped to Nevada by dedicated rail service or by *general freight rail service*. With dedicated rail or general freight service to Nevada, the railcars carrying spent nuclear fuel or high-level radioactive waste could be parked on a side track (off the main rail line) at the connection point until a train could be assembled to travel to the repository site. A small secure railyard off the main rail line would be established for switching operations. Railcars with spent nuclear fuel or high-level radioactive waste would have to be moved within 48 hours in accordance with U.S. Department of Transportation regulations (49 CFR 174.14).

This EIS assumes there would be about four trains per week for shipments of spent nuclear fuel and high-level radioactive waste to the repository. In addition, the rail line would enable the transport of other material to the repository, including empty disposal containers, bulk concrete materials, steel, large equipment, and general building materials. The EIS assumes one train per week for this other material for a total of about five trains per week to the repository from about 2010 to 2033.

2.1.3.3.3 Nevada Heavy-Haul Truck Scenario

Under this scenario, rail shipments to Nevada would go to an intermodal transfer station where shipping casks would transfer from railcars to heavy-haul trucks. The heavy-haul trucks would travel on existing roads to the repository, once the roads were appropriately upgraded. The following sections describe the implementing alternatives (the intermodal transfer station locations and associated highway routes for heavy-haul trucks) that the EIS analyzes.

2.1.3.3.3.1 Intermodal Transfer Stations. To enable intermodal transfers and heavy-haul shipments to the repository, an intermodal transfer station would be built and operated in Nevada. DOE

is considering three potential locations for intermodal transfer operations: near Caliente, northeast of Las Vegas (Apex/Dry Lake), and southwest of Las Vegas (Sloan/Jean) (Figure 2-27). DOE has identified general areas at these three locations where it could build and operate an intermodal transfer station:

- ***Caliente Intermodal Transfer Station Implementing Alternative.*** The Caliente siting areas are south of Caliente in the Meadow Valley Wash. DOE has identified two possible areas along the west side of the wash.
- ***Apex/Dry Lake Intermodal Transfer Station Implementing Alternative.*** The areas for a potential station are northeast of Las Vegas along the Union Pacific Railroad's main line at Dry Lake and Apex. Three areas are available for intermodal transfer station siting. The first area is directly adjacent to the Dry Lake siding along the west side of the Union Pacific line. The second area is smaller and lies on the same side of the tracks a short distance northeast of the first area. The third area is between Interstate 15 and the Union Pacific tracks south of where the tracks cross the Interstate. Because this area is between the Dry Lake and Apex sidings, the construction of an additional rail siding would be necessary.
- ***Sloan/Jean Intermodal Transfer Station Implementing Alternative.*** The potential areas for an intermodal transfer station southwest of Las Vegas are between the existing Union Pacific rail sidings at Sloan and Jean. One area is on the west side of I-15, north of the Union Pacific rail underpass at I-15. The second is south of the Sloan rail siding along the east side of the rail line. A third area is south of the second, directly north of the Jean interchange on I-15.

The intermodal transfer station would be a fenced area of about 250 meters (820 feet) by 250 meters and a rail siding that would be about 2 kilometers (1.2 miles) long (see Figure 2-28). The estimated total area occupied by the facility and support areas would be about 0.2 square kilometer (50 acres). It would include rail tracks, two shipping cask transfer cranes (one on a gantry rail, and one on a backup rubber-tired vehicle), an office building, and a maintenance and security building. It would also have connection tracks to the existing Union Pacific line and storage and transfer tracks inside the station boundary. The maintenance building would provide space for routine service and minor repairs to the heavy-haul trailers and tractors. The station would have power, water, and other services. Diesel generators would provide a backup electric power source. Construction of an intermodal transfer station would take an estimated 1.5 years.

Trains would switch from the main Union Pacific track to an existing or newly constructed passing track. The railcars carrying casks of spent nuclear fuel or high-level radioactive waste would be uncoupled from the train and switched to the intermodal transfer station track. The train would return to the main Union Pacific line. A railyard locomotive would move the cars containing the casks to the station.

The loading and unloading process would begin with the return of a heavy-haul truck from the repository. The empty cask returning from the repository would be lifted from the truck, loaded on an empty railcar, and secured. The gantry or mobile crane would then remove a loaded cask from another railcar and transfer it to the same truck, where it would be secured and inspected before shipment to the repository.

The station would accept railcars as they arrived (24 hours a day, 7 days a week), but it would normally dispatch heavy-haul trucks during early morning daylight hours on weekdays, consistent with current Nevada heavy-haul shipment practices.

Intermodal transfer station operations would not depend on whether the railcars that carried spent nuclear fuel and high-level radioactive waste arrived on dedicated or general freight trains.

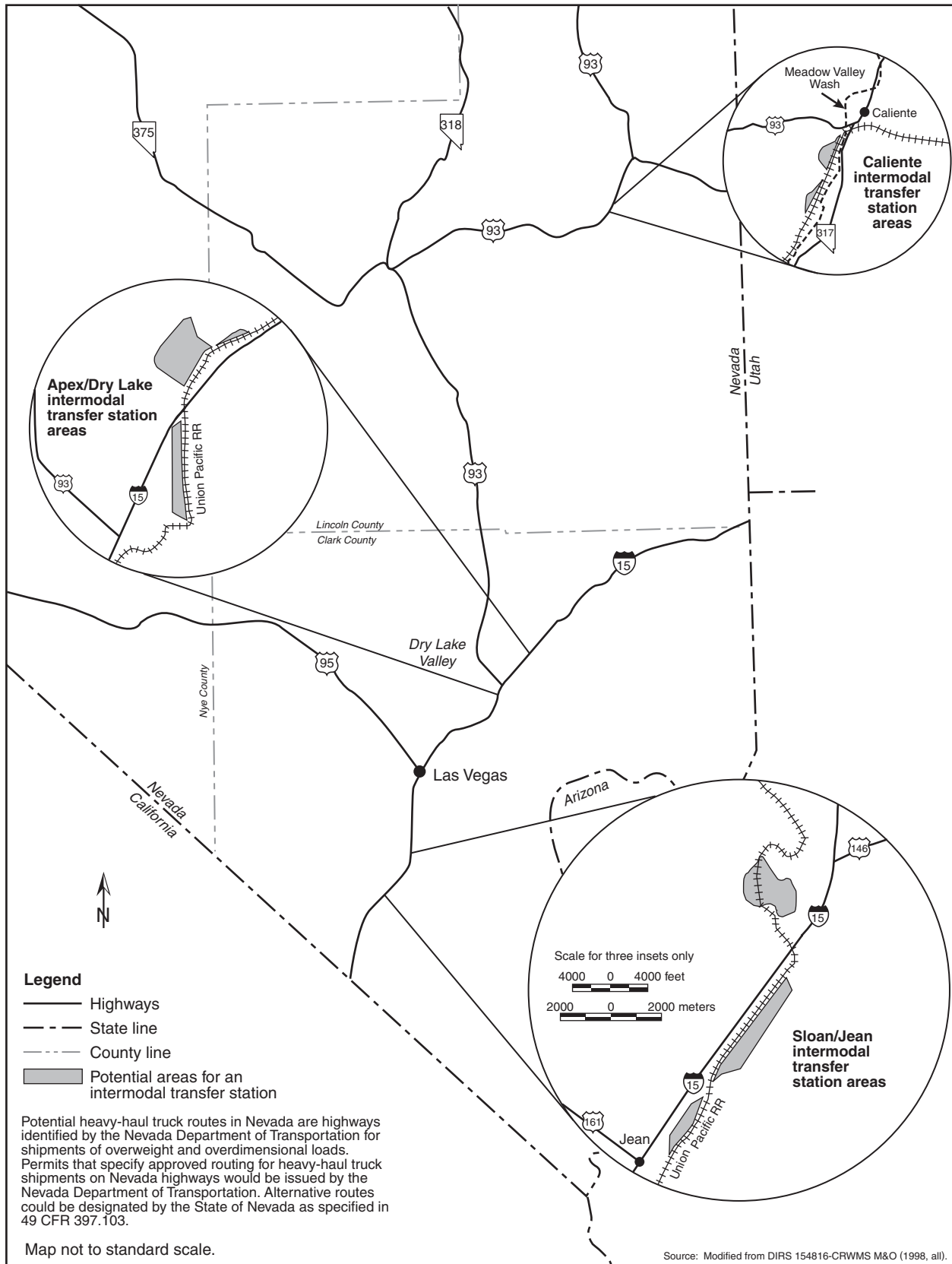


Figure 2-27. Potential intermodal transfer station locations.

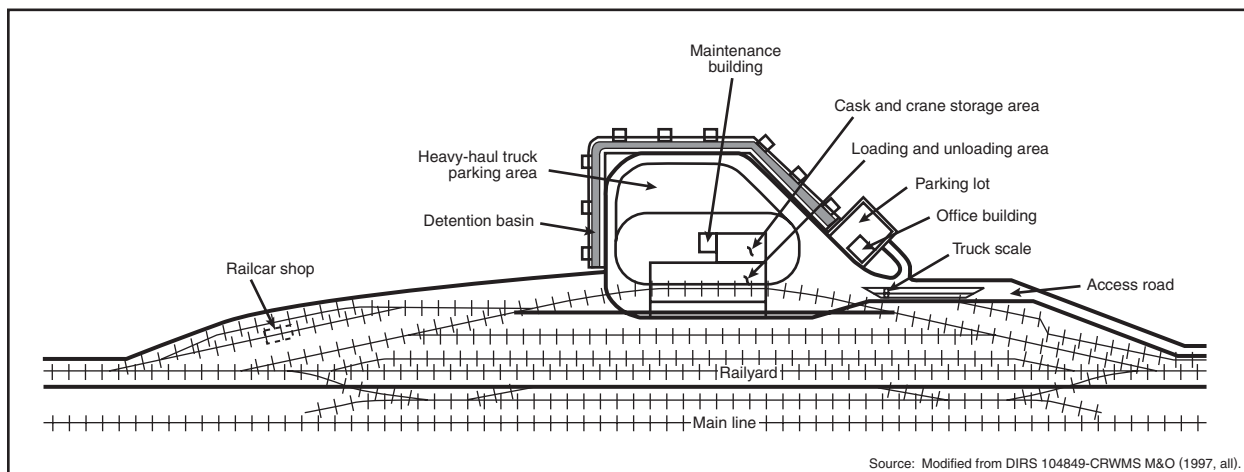


Figure 2-28. Conceptual diagram of intermodal transfer station layout.

At the completion of the 24 years of shipping, the intermodal transfer station would be decommissioned and, if possible, reused.

2.1.3.3.3.2 Highway Routes for Heavy-Haul Shipments. Figure 2-29 is an illustration of a heavy-haul truck that DOE could use to transport spent nuclear fuel and high-level radioactive waste to the repository. The heavy-haul truck would weigh about 91,000 kilograms (200,000 pounds) unloaded and would be up to 67 meters (220 feet) long. It would be custom-built for repository shipments. Typical range of open-road speeds would be 32 to 80 kilometers (20 to 50 miles) per hour.

Heavy-haul truck shipments from an intermodal transfer station to the repository would comply with U.S. Department of Transportation requirements for shipments of highway route-controlled quantities of radioactive materials (49 CFR Part 177) and with State of Nevada permit requirements for heavy-haul shipments. Nevada permits heavy-haul shipments on Monday through Friday (excluding holidays) but only in daylight hours.

Road upgrades for candidate routes, if necessary, would involve four kinds of construction activities: (1) widening the shoulders and constructing turnouts and truck lanes, (2) upgrading intersections that are inadequate for heavy-haul truck traffic, (3) increasing the asphalt thickness (overlay) of some sections, and (4) upgrading engineered structures such as culverts and bridges. The overlay work would include upgrades needed to remove frost restrictions from some road sections.

Shoulder widening and the construction of turnouts and truck lanes would occur as needed along the side of the existing pavement. Shoulders would be widened from 0.33 or 0.66 meter (1 or 2 feet) to 1.2 meters (4 feet). Widening would build the existing shoulder up to pavement height. Truck lanes would be built on roadways with grades exceeding 4 percent. Turnout lanes would be built approximately every 8 to 32 kilometers (5 to 20 miles) depending on projected traffic. The truck lanes and turnouts would require land clearing and soil excavation or fill to establish the roadway. Culverts under the roadway would be lengthened. DOE assumes that most borrow material for construction could come from existing Nevada Department of Transportation borrow areas. Asphalt could be produced at a portable plant in the borrow areas. Appendix J contains descriptions of the specific highway improvements for the five routes.

The following paragraphs describe the potential highway routes for heavy-haul trucks DOE is considering for the intermodal transfer station location and unique operational considerations for each route.

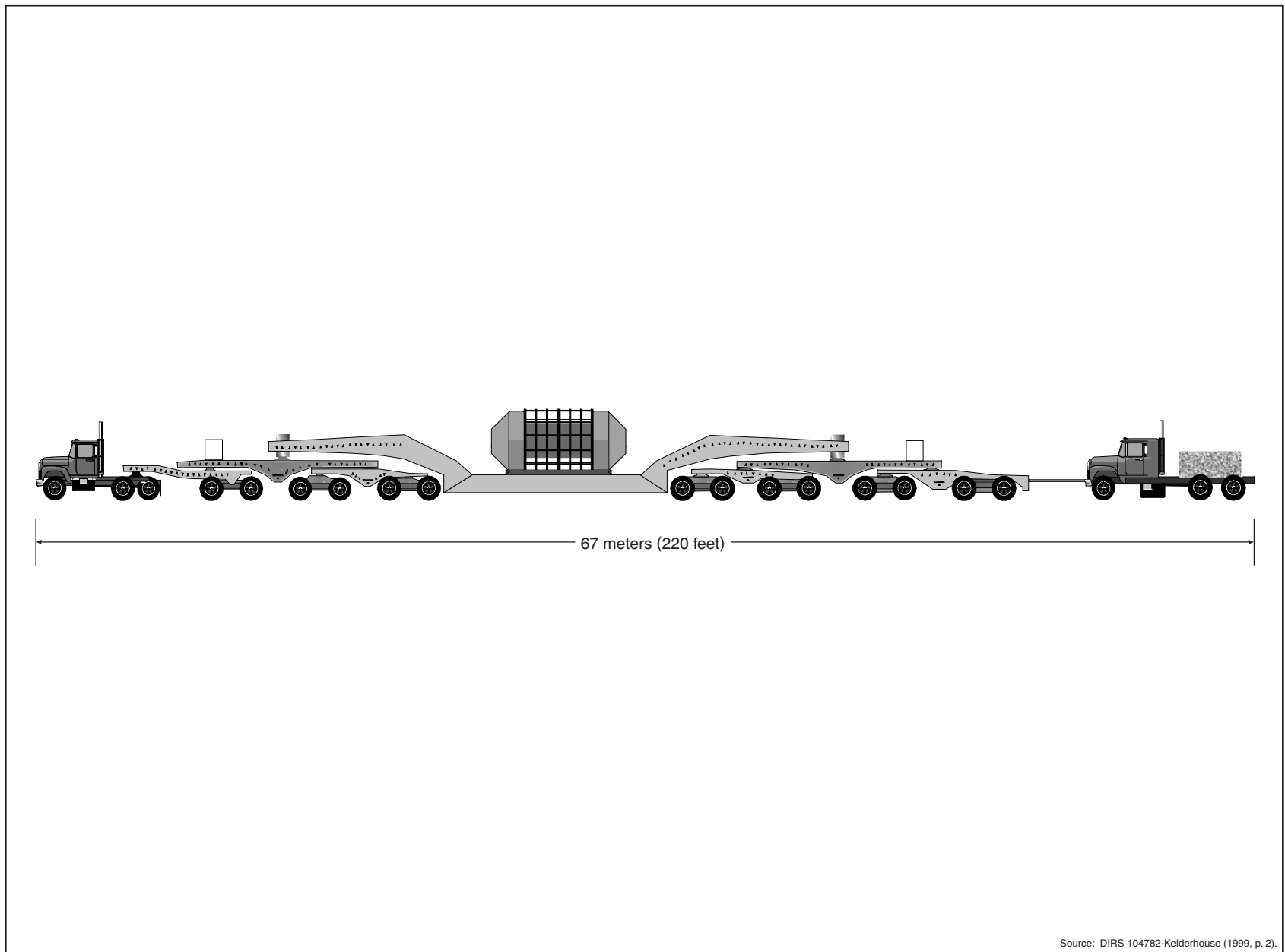


Figure 2-29. Artist's conception of a heavy-haul truck carrying a rail shipping cask.

- **Caliente Intermodal Transfer Station Highway Routes.** Heavy-haul trucks leaving the Caliente intermodal transfer station could travel on one of three potential routes: (1) Caliente, (2) Caliente/Chalk Mountain, and (3) Caliente/Las Vegas (see Figure 2-30).

The Caliente route would be approximately 533 kilometers (331 miles) long. Heavy-haul trucks leaving an intermodal transfer station in the Caliente area would travel directly from the station to U.S. Highway 93. The trucks would travel west on U.S. 93 to State Route 375, then on State Route 375 to the intersection with U.S. Highway 6. The trucks would continue on U.S. 6 to the intersection with U.S. 95 in Tonopah, then into Beatty on U.S. 95, where an *alternate* truck route would be built because the existing intersection is too constricted to allow a turn. Heavy-haul trucks would then travel south on U.S. 95 to the Lathrop Wells Road exit, which accesses the Yucca Mountain site. Because of the estimated travel time associated with the Caliente route and the restriction on nighttime travel for heavy-haul vehicles, DOE would construct a parking area along the route to enable these vehicles to park overnight. This parking area would be near the U.S. 6 and U.S. 95 interchange at Tonopah.

The Caliente/Chalk Mountain route would be approximately 282 kilometers (175 miles) long. Heavy-haul trucks leaving an intermodal transfer station in the Caliente area would travel directly from the station to U.S. 93. The trucks would travel on U.S. 93 to State Route 375, on State Route 375 to Rachel, and head south through the Nellis Air Force Range to the Nevada Test Site.

The Caliente/Las Vegas route would be approximately 376 kilometers (234 miles) long. Heavy-haul trucks leaving an intermodal transfer station in the Caliente area would travel directly from the station to U.S. 93. The trucks would travel south on U.S. 93 to the intersection with I-15, northeast of Las Vegas. The trucks would travel south on I-15 to the exit for the proposed northern Las Vegas Beltway, then would travel west on the beltway. They would leave the beltway at U.S. 95, and head north on U.S. 95 to the Nevada Test Site. The trucks would travel on Jackass Flats Road on the Nevada Test Site to the Yucca Mountain site.

- **Apex/Dry Lake Intermodal Transfer Station Highway Route.** Heavy-haul trucks would leave the intermodal transfer station at the Apex/Dry Lake location and enter I-15 at the Apex interchange. The trucks would travel south on I-15 to the exit to the proposed northern Las Vegas Beltway, and would travel west on the beltway. The trucks would leave the beltway at U.S. 95, and travel north on U.S. 95 to the Nevada Test Site. They would then travel on Jackass Flats Road on the Nevada Test Site to the Yucca Mountain site. This route is about 183 kilometers (114 miles) long (see Figure 2-30).
- **Sloan/Jean Intermodal Transfer Station Highway Route.** Heavy-haul trucks leaving a Sloan/Jean intermodal transfer station would enter I-15 at the Sloan interchange. The trucks would travel on I-15 to the exit to the southern portion of the proposed Las Vegas Beltway, and then travel northwest on the beltway. They would leave the beltway at U.S. 95, and travel to the Nevada Test Site. They would then travel on Jackass Flats Road to the Yucca Mountain site. This route would be approximately 190 kilometers (118 miles) long (see Figure 2-30).

2.1.3.4 Shipping Cask Manufacturing, Maintenance, and Disposal

To transport spent nuclear fuel and high-level radioactive waste to the repository, DOE would use existing or new shipping casks that met Nuclear Regulatory Commission regulations (10 CFR Part 71). One or more qualified companies that provide specialized metal structures, tanks, and other heavy equipment would manufacture new shipping casks. The number and type of shipping casks required would depend on the predominant mode of transportation.

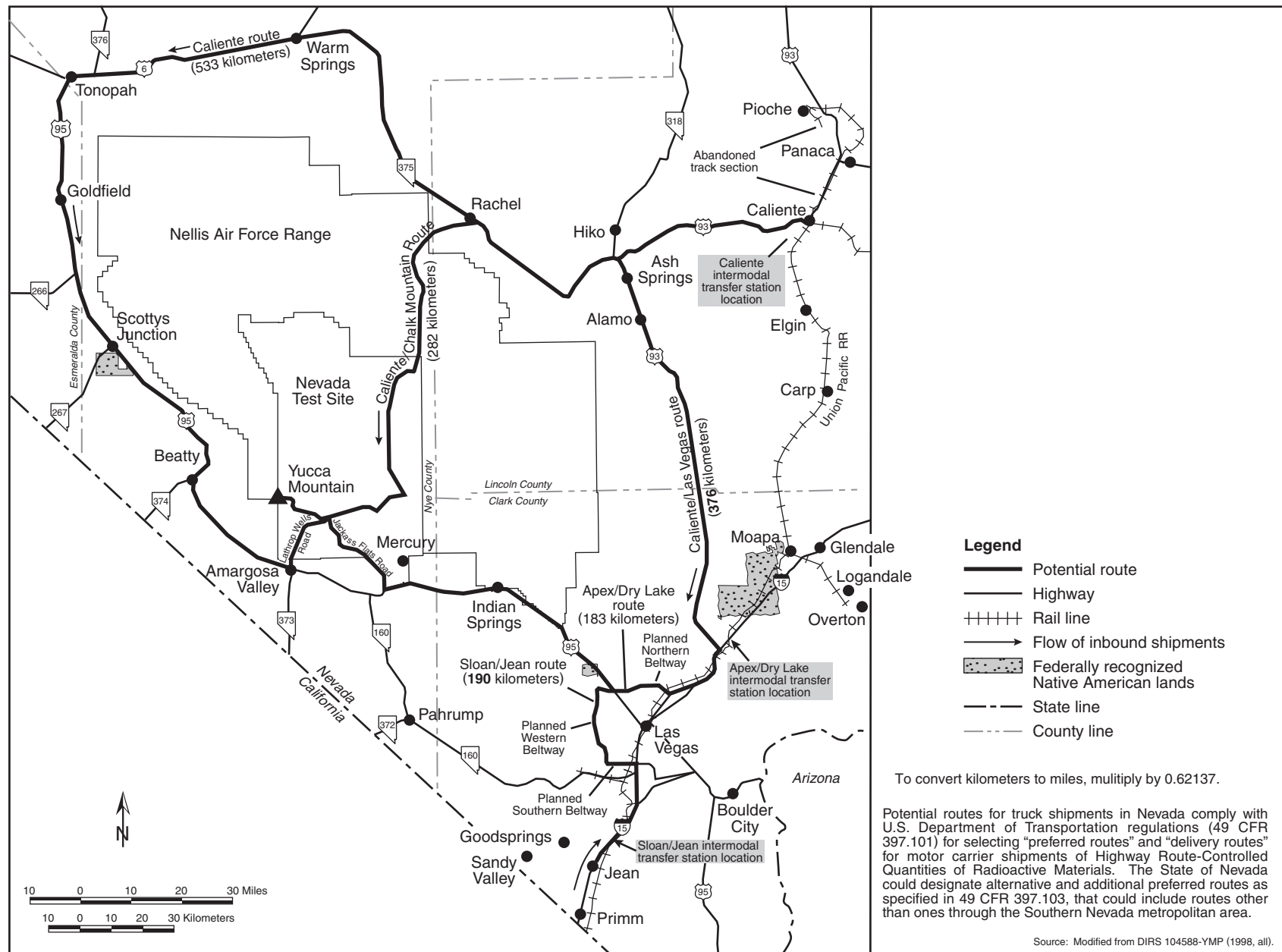


Figure 2-30. Potential routes in Nevada for heavy-haul trucks.

DOE would remove casks from service periodically for maintenance and inspection. These activities would occur at a cask maintenance facility(s) where cask functions and components would be checked and inspected in compliance with Nuclear Regulatory Commission requirements and preventive maintenance procedures. The major operations involved in cask maintenance would include decontamination, replacement of limited-life components such as O-rings, and verification of radiation shielding integrity, structural integrity, and heat transfer efficiency.

The large number of repository shipments would require new facilities for cask maintenance. DOE has not decided where in the United States it would locate a cask maintenance facility(s), but this EIS assumes that such a facility would be at the repository inside the Restricted Area at the North Portal on approximately 0.01 square kilometer (2.5 acres). Minor cask maintenance activities could occur at commercial or DOE sites.

2.1.4 ALTERNATIVE DESIGN CONCEPTS AND DESIGN FEATURES

DOE used the preliminary design concept in the *Viability Assessment of a Repository at Yucca Mountain* (DIRS 101779-DOE 1998, all), referred to as the Viability Assessment reference design, to evaluate impacts in the Draft EIS. While it was preparing the Draft EIS, DOE considered a broad range of design features and alternatives that would enhance the VA reference design within the License Application Design Selection process (DIRS 107292-CRWMS M&O 1999, all). In addition, the features and alternatives were combined into groups called *enhanced design alternatives*, each of which defined a unique design concept for the repository. DOE anticipated choosing an enhanced design alternative that it could carry forward to the licensing process.

The final *License Application Design Selection Report* (DIRS 107292-CRWMS M&O 1999, all) recommended Enhanced Design Alternative II (EDA II) to carry forward in the design evolution. However, DOE did specify that backfill should be only a possible option in EDA II. Accordingly, DOE adopted EDA II without backfill as the design to be evaluated for the purpose of making a determination on site recommendation, as documented in the Science and Engineering Report (DIRS 153849-DOE 2001, all). EDA II without backfill, over a range of thermal operating modes, was evaluated in the Supplement to the Draft EIS and is also the basis for this Final EIS.

The following section qualitatively discusses potential future design features and alternatives. Appendix E provides further detail on alternative design concepts and alternatives and their potential environmental impacts.

2.1.4.1 Design Features and Alternatives To Control the Thermal/Moisture Environment in the Repository and To Limit Release and Transport of Radionuclides

Through successive evaluations and improvements, the repository design has evolved to the flexible design. This represents the current state of the ongoing process that identifies and develops ideas through conceptual, then preliminary, then more detailed designs to produce a design that DOE would use for purposes of the Secretary of Energy's determination of whether to recommend approval of the Yucca Mountain site to the President for development of a geologic repository. Coupled with information from ongoing scientific tests and investigations, the design process continues to provide insights into how to improve repository performance and reduce uncertainties in performance projections.

A key to the determination on site recommendation is demonstrating whether a repository at Yucca Mountain would be likely to meet regulatory standards. To that end, scientific tests and studies identify and quantify uncertainties in performance assessment and confirm performance projections. Due to limitations in the understanding of natural processes that might occur over thousands of years, as well as the limits on being able to characterize the site fully, uncertainties in performance assessments can never